Farmers' Bulletin 1102 United States Department of Agriculture

THE CROW IN ITS RELATION TO AGRICULTURE

Is It a Farm Pest?

THE CROW is best known by the unfavorable reputation it has acquired in the cornfield. Notorious also are its raids on the poultry yard, its depredations on wild birds, and its attacks on crops other than corn.

Less heralded, however, but no less important to the farmer, is the crow's warfare on insect pests. Insects supply about one-fifth of its food, and those preyed upon include some of the worst pests with which the farmer has to contend—grasshoppers, caterpillars, and white grubs and their parents, May beetles.

From the evidence at hand the crow's merits and shortcomings appear about equally divided. While it would be unwise to give it absolute protection, and thus afford the farmer no recourse when the bird is doing damage, it would be equally unwise to adopt the policy of killing every crow that comes within gunshot.

Much of the good the crow does can ill be spared, and the damage it inflicts may be materially lessened by proper measures against such birds as prove to be a nuisance.

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Contribution from the Bureau of Biological Survey
E. W. NELSON, Chief
Washington, D. C. August, 1920

THE CROW IN ITS RELATION TO AGRICULTURE.

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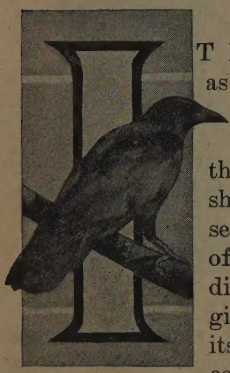

IT IS DOUBTFUL whether any other bird is of as great economic importance to the farmer of the eastern United States as the crow. In food habits it is practically omnivorous; it takes anything from the choicest poultry and the tenderest shoots of sprouting grain to carrion and weed seeds, many of which offer at best but a morsel of nourishment. The fact that no less than 656 different items have been identified in its food gives some idea of the bird's resourcefulness and its potentiality for good or harm. Some of the complaints against the crow are well-nigh traditional, while a few of its beneficial habits have long been matters of common knowledge. Irreconcilable differences of opinion regarding the crow's worth have often been the rule among residents of a community, and it has been only recently that sufficient information has been assembled from most parts of the bird's range to allow a thorough study of its habits.[1]

[1] For a comprehensive treatise on the economic status of the crow based on the examination of the food contained in 2,118 stomachs, see Bulletin No. 621, U. S. Dept. Agr., "The Crow and Its Relation to Man," by E. R. Kalmbach, 92 pp., 2 pls., 3 figs., Feb. 16, 1918.

DISTRIBUTION AND ABUNDANCE.

Although the crow is so well known to farmers in the Eastern States that one would hardly suppose it could be confused with other birds, considerable uncertainty in identification exists in regions where it is scarce or where its range overlaps that of closely related species. Ordinarily little distinction is made by the residents of the South Atlantic coast between the common crow and the fish crow—a bird of quite different habits; and the same lack of distinction is shown by the average individual of the northwest coast, where the northwestern crow, also a maritime species, mingles with the common form. In the Southwest the small white-necked raven is frequently called a crow, and in some other parts of the West even the larger ravens have been similarly misnamed.

There are within the borders of the United States three species of crows. By far the most abundant and widely distributed form is the common crow.[1] This bird, with its three closely related varieties, the Florida crow,[2] the southern crow,[3] and the western crow,[4] occupies a range comprising practically all of our country east of the Rocky Mountains, as well as sections in the Northwest and along our western coast as far as southern California. It also is found locally in parts of Arizona and New Mexico. The other two species are smaller and of maritime habits. The fish crow,[5] whose notes are not greatly different from those of the young of the common crow, occupies a narrow strip along the Atlantic and Gulf coasts from Connecticut to Texas, and is seldom found more than twenty miles from salt water. Its counterpart, the northwestern crow,[6] which some authorities consider simply a subspecific form of the common crow, occupies the Pacific coastal region from Puget Sound to southern Alaska.

The white-necked raven,[7] inhabiting the arid and semiarid sections of Texas and southern New Mexico and Arizona, is the raven most frequently confused with the crow. This bird's slightly greater size, the white bases of the feathers of its neck, and its restricted range, however, serve to identify it. The northern raven,[8] found along our northern boundary and at higher altitudes farther south, and the common raven,[9] present in numbers in the States west of the Great Plains, may be distinguished by their greater size and by their discordant notes, which possess none of the lusty, open-throated quality of those of the crow.

In this bulletin the name "crow" has been used to cover the four forms of the common crow, including the close relatives, the Florida, southern, and western crows.[10] The food habits of all these are es-

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[1] *Corvus brachyrhynchos brachyrhynchos.*
[2] *Corvus brachyrhynchos pascuus.*
[3] *Corvus brachyrhynchos paulus.*
[4] *Corvus brachyrhynchos hesperis.*
[5] *Corvus ossifragus.*
[6] *Corvus caurinus.*
[7] *Corvus cryptoleucus.*
[8] *Corvus corax principalis.*
[9] *Corvus corax sinuatus.*
[10] *Corvus brachyrhynchos,* four subspecies.

sentially the same, differing only to an extent occasioned by the varying character of the food supply in the different parts of the area covered by their combined ranges. In some of the Western States, where the crow appears only as an occasional breeder, it has little economic significance, as in Nevada and the greater parts of Arizona, New Mexico, Colorado, Wyoming, Utah, Idaho, and parts of Washington and Oregon. It can be considered only locally abundant in California. The western parts of Texas, Oklahoma, Kansas, and

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FIG. 1.—Young crows nearly ready to leave the nest.

Nebraska support very few crows; and in large areas of Montana, North Dakota, and South Dakota, and in the Gulf States of Florida, Alabama, Mississippi, and Louisiana crows are not common. Based on the average yearly abundance, the crow exerts its greatest economic influence in the States along the Atlantic coast north of North Carolina and in the central and upper Mississippi Valley.

LIFE HISTORY.

The nest of the crow is built at heights varying from 20 to 60 feet, and during the breeding season it is usually well concealed from below by foliage. Sometimes it is placed in the dense top of a pine, but oaks and elms of the river bottoms, and, in the West, cottonwoods are equally acceptable. The nests are rarely found in deep forests. In

the East the hilly and partially wooded sections of New Jersey, New York, and Pennsylvania seem to meet nesting requirements; in Ohio, Indiana, and Illinois the low fertile river bottoms are especially attractive; and farther west the limited tree growth confines the breeding activities of crows to the neighborhood of streams.

Crows raise one brood of from 3 to 7 young (see fig. 1). In the Southern States the young may be found in the nest as early as the middle of March and farther north correspondingly later, so that along our northern border they may be present as late as July. The nestling life lasts about three weeks. For some time after the brood of the year has left the nest, in July, August, and September, crows may be found in family parties or in small, loose flocks of 10 or a

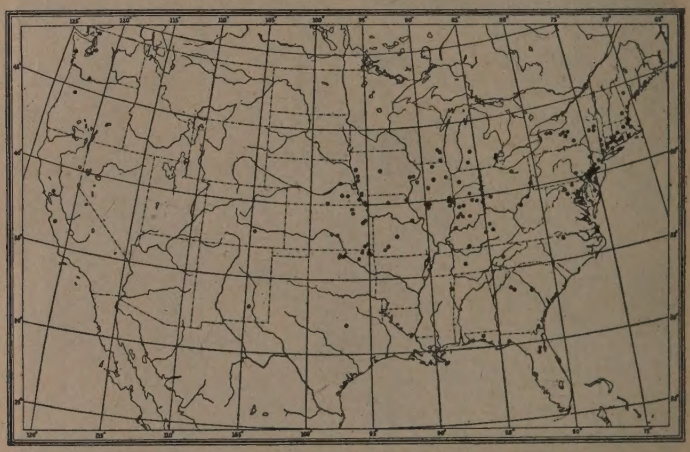

FIG. 2.—Location of crow roosts known to have been occupied in the winter of 1911–12.

dozen, securing much of their food from grasshoppers and ripening corn.

While crows are more or less clannish, even in the nesting season, their gregarious habit is most highly developed during the colder months, when, often by thousands, they resort to their nightly roosts. This flocking is of considerable economic significance in that it results in the gathering together of large numbers of birds possessing some injurious habits. In the latitude of Washington, D. C., their roosts are well established by the end of September, and by midwinter their combined southerly migration and gregarious habits have brought together in a comparatively small area the bulk of the crow population of North America. From October to March the States lying in the area between Connecticut and Iowa and south to

Virginia and Oklahoma harbor crows in extremely large numbers, and damage often results in places where crops are left in the fields until late in fall. On the accompanying map (fig. 2) are recorded crow roosts known to have been occupied in the winter of 1911–12.

ECONOMIC STATUS.

What a bird eats or does not eat is the first question to be answered in an inquiry into its economic status. To determine with accuracy the various items entering into its diet nothing has been found more reliable than the examination of stomach contents. In the case of the crow such examination has been made of an excellent series of 2,118 stomachs, collected in 40 States, the District of Columbia, and several Canadian Provinces. Of these stomachs 1,340 were of adult crows and 778 of nestlings.

ANIMAL FOOD.

About 28 per cent of the yearly food of the adult crow consists of animal matter. In this are found insects, spiders, millipeds, crustaceans, snails, the remains of reptiles, amphibians, wild birds and their eggs, poultry and their eggs, small mammals, and carrion.

INSECTS.

Over two-thirds of the animal food, or about a fifth of the whole diet of the crow, is composed of insects, and these include many of the most destructive pests with which the farmer has to deal. The crow is primarily a terrestrial feeder. Its share of insects, therefore, is made up almost exclusively of species found on or near the ground, or those which it secures from beneath the surface by turning over sticks, clods of earth, or dung. The latter is a common method of feeding employed diligently by the crow from early spring to the beginning of autumn, when the usual crop of grasshoppers furnishes a more accessible supply of food.

Beetles of various kinds constitute about 7.5 per cent of the crow's annual food. They are a promiscuous lot, some beneficial, some neutral, and others, which comprise the major portion, highly injurious. Among the injurious are May beetles and their larvæ, white grubs; also click beetles, weevils, and some of the ground beetles which have vegetarian food habits. Orthoptera, including grasshoppers, locusts, and crickets, form about an equal quantity (7.33 per cent), but the damage this order of insects inflicts far exceeds that done by the various beetles eaten. The short-horned grasshoppers especially are destructive, and, while these insects have never been such serious pests in the Eastern States as in some parts of the West, the annual toll taken by them throughout the country amounts to many millions of dollars. In August and September grasshoppers form

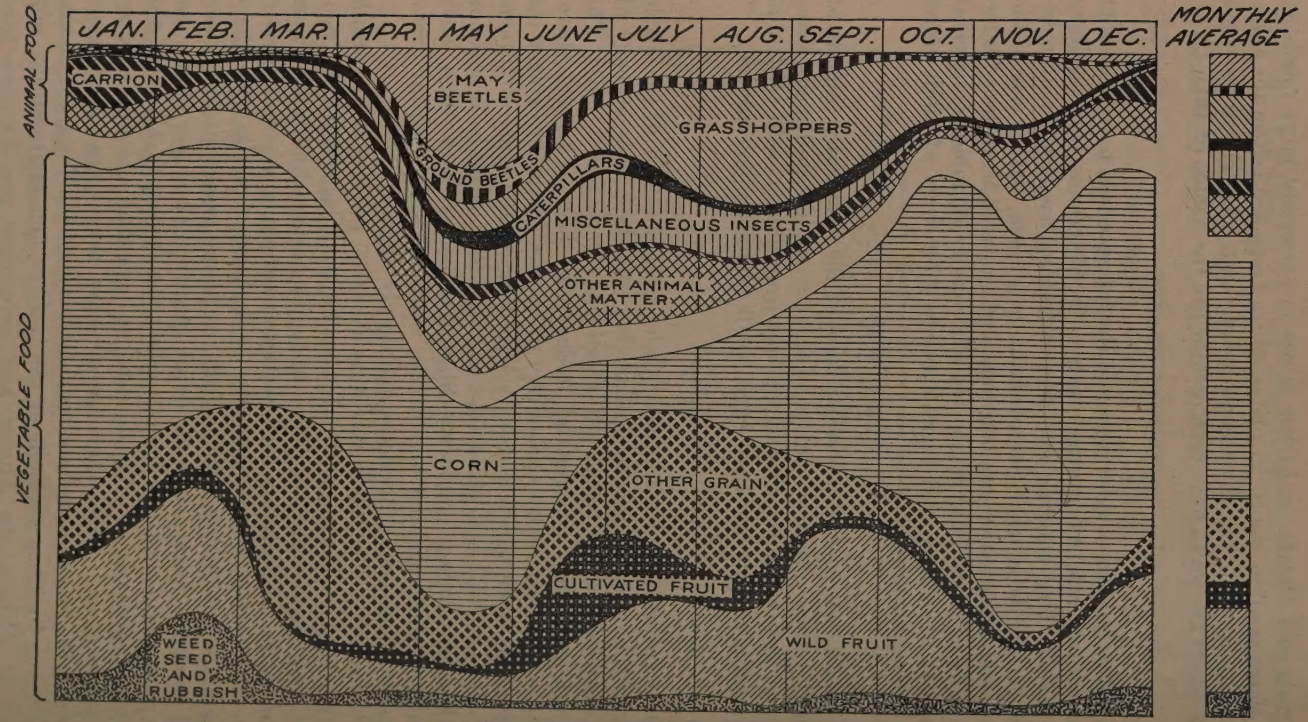

FIG. 3.—Food of adult crows. Showing the varying quantities of the principal items from month to month, and the relative monthly average of each item. In Table I is presented the same information in percentages.

nearly one-fifth of the crow's food. Caterpillars form about 1.5 per cent of the diet of the adults; nestlings, however, eat nearly four times as much. Other insects, as bees, wasps, ants, flies, and true bugs, are taken in only small quantities, and the economic problems involved are not important.

The numbers of the various insects eaten during different months of the year are often indicative of their period of abundance. Early in spring, for instance, few May beetles or other scarabæid beetles are eaten; but, beginning in April, they form about 5 per cent of the crow's food, and in May the presence of the annual crop of May beetles is indicated by the extraordinary percentage of 20.99. Likewise the monthly increase of grasshoppers from May to September is shown in the crow's diet by the approximate percentages of 4, 6, 14, 19, and 19, representing the proportion of these in the food taken. The height of the caterpillar season also is indicated by the approximate percentages of 1, 3, 6, and 2, for the months of April, May, June, and July, respectively.

TABLE I.—*Monthly percentages of the principal food items of the adult crow.*

Kind of food.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
May beetles, etc.	0.18	1.19	1.04	4.98	20.79	10.06	4.47	5.26	0.91	0.54	0.77	1.17	4.28
Ground beetles	.07	.10	.26	2.30	5.54	3.24	2.13	1.76	2.31	.14	.74	.19	1.56
Grasshoppers	.51	1.14	.56	1.84	4.29	5.83	14.04	19.14	19.24	8.68	10.73	2.07	7.34
Caterpillars	.18	.41	1.36	1.13	2.71	6.41	1.95	.62	2.12	1.19	.30	.39	1.56
Miscellaneous insects	.35	2.01	1.36	4.47	6.44	10.41	11.26	8.29	3.06	.96	1.62	.67	4.23
Carrion	8.95	2.45	2.66	5.24	2.13	1.48	.29	.95	2.69	.32	1.44	2.37	2.53
Other miscellaneous animal matter	4.70	3.67	8.81	14.13	10.56	9.55	10.14	3.38	1.99	2.46	3.14	6.32	6.57
Corn	51.95	43.19	36.85	35.28	33.26	20.53	9.13	17.96	29.60	54.33	63.93	65.00	38.42
Other grain	7.00	9.74	34.22	20.90	8.43	10.20	20.22	22.80	8.33	7.08	2.67	.89	12.70
Cultivated fruit	2.55	3.42	.26	2.74	.91	14.12	9.31	5.79	1.66	2.40	.07	1.36	3.74
Wild fruit	19.76	19.57	10.65	5.06	3.49	7.28	14.05	13.67	25.82	20.50	12.94	14.75	13.96
Weed seeds and rubbish	3.80	13.11	1.97	1.93	1.45	.89	3.01	.38	2.27	1.40	1.65	4.82	3.06

The size and the voracious appetites of crows make these birds especially valuable in times of outbreak of one or another of the insect pests upon which they feed. In the stomach of a crow collected in April were the remains of 85 May beetles, and these formed less than half the food; in another were 72 wireworms; and in a third were fragments of 123 grasshoppers. Twelve birds in a series collected in Manitoba had fed on grasshoppers at the average rate of 57 each, and one crow secured in Michigan had eaten 483 small caterpillars. Nestling crows, whose rapidly growing bodies require even greater quantities of insect food than the adults, often excel their parents in the good work of insect destruction. One brood of 4 had consumed 418 grasshoppers, and another brood of 7 had made away with 585 during a few hours before they were collected. Of a total of 157 nestling crows secured in Kansas in 1913, 151 had been fed on grasshoppers. Caterpillars, always a favorite source of food for nestling

birds, were present in over a third of the 778 nestling-crow stomachs examined.

Summing up, it may be said that the character of the insect food of the crow leaves little to be desired and becomes the strongest argument in the bird's favor. While fully applicable to the adult birds, this statement is doubly true of the nestlings, whose rapidly growing bodies require enormous quantities of such readily digestible food as is furnished by soft-bodied insects.

Spiders, Fishes, Reptiles, Etc.

In the other animal food of the crow are items that reflect some of the bird's less-admired habits. The aggregate consumption of spiders, millipeds, crustaceans, mollusks, fishes, and carrion may be considered as having a slight influence for good, but the destruction of beneficial toads, frogs, and small snakes is against the bird. Fortunately, however, the quantity of such material eaten is small, slightly more than 1 per cent of the yearly food.

Wild Birds and Their Eggs.

Because of its depredations on small wild birds and its destruction of the nests and eggs of larger game species, the crow has received the condemnation of bird lovers and sportsmen. While stomach examination has, to an extent, verified this accusation, it has at the same time disproved extravagant statements. About a third of 1 per cent of the annual food of adult crows and 1.5 per cent of that of nestlings is derived from wild birds and their eggs, and about 1 in every 28 adult crows and 1 in every 11 nestlings examined had eaten such food. In the case of the nestlings, however, this ratio gives an exaggerated idea of the work done, as in many instances several members of a brood had fed on parts of the same victim. A mitigating circumstance in connection with the destruction of the eggs of wild birds lies in the fact that most of it is done during the nesting season of the crow—a time early enough in the year to allow the species attacked to lay a second set of eggs that will be little molested by crows. Nevertheless, on game farms and preserves, and in suburban districts where it is the desire to foster small birds, the crow population must be held in check.

Poultry and Their Eggs.

The crow's depredations on poultry and their eggs are governed largely by local conditions. The proximity of a crow's nest containing a brood of voracious young, the accessibility of some particular poultry yard, and the overdevelopment in certain individual crows of this obnoxious habit, are factors accountable for most of the losses to poultry raisers from crows. Reports of striking simi-

larity often come from localities widely separated, while circumstances diametrically opposite have been reported from neighboring farms. Food of this sort forms an extremely small part of the annual diet of the crow, less than 1 per cent (0.57) of the adult's and 1.6 per cent of the nestling's. As in feeding on wild birds, the crow's visits to the poultry yard are most frequent during the period when it has young to feed; as a consequence, successful protective measures undertaken in May, June, and July will reduce to a minimum the crow's depredations on poultry.

Mammals.

In feeding on mammals the crow supplements the good work of hawks and owls by tending to hold in check rodent pests. Such food forms 1.6 per cent of the diet of adult crows and 8.8 per cent of nestlings. Their favorite mammal food consists of young cottontail rabbits. While the crow does molest such live stock as young lambs and swine, this is only an occasional habit when the bird is hard pressed for food. Fortunately such work is not common and the aggregate loss of this kind is negligible.

Carrion and the Distribution of Live-Stock Diseases.

As a carrion feeder the crow ably supplements the good work of the turkey buzzard, especially along river banks and tidal flats, where dead fish furnish a supply of animal matter much needed during winter. But, from its carrion-feeding habits, the crow has been accused of being a potent agency in the transmission of live-stock diseases, especially hog cholera. No doubt the transmission of this disease by the crow is within the range of possibilities, either by the carrying of virus attached to its feet, bill, or other parts of its body or possibly by the depositing of infected excreta after the bird had fed on the body of an animal that had died from the disease. However, by the immediate burying of the dead bodies of diseased animals and the employment of rigid sanitary measures in outbreaks of this kind, the incentives which usually attract these birds may be eliminated. It is well to add that many other agents in the spread of such diseases, including dogs, cats, and innumerable insects, are as potent in the dissemination of bacteria as are crows. All of these can be made innocuous by thorough methods of sanitation, while the extermination of the crow would eliminate only one of many means by which such diseases are transferred.

Vegetable Food.

Corn.

Vegetable matter forms nearly 72 per cent of the adult crow's yearly food, and over half of it consists of corn. In November, De-

cember, and January this grain forms over half the diet, but most of it is waste, gleaned from scattered unharvested ears. During the sprouting season of April and May, corn constitutes about a third of the food, and at the harvest in October it again supplies over half. Of 1,340 adult crows collected in varying numbers in every month of the year, 824 (over 61 per cent) had fed on corn.

It is the belief of some farmers that the depredations on this grain in sprouting time are due largely to the nestlings' desire for the soft, germinating kernel. Stomach analysis has disproved this, and has showed that corn formed less than an eighth of the young crow's food, one-third the quantity taken by the adults during approximately the same time. Injury to this crop may be either to sprouting corn, to corn "in the milk" or in the "roasting-ear" stage, or when the ripened grain has been stacked in shocks. Of the three, the last form of injury is the least serious; the pulling of sprouting corn sometimes results in heavy losses, but fortunately such damage may be reduced by the use of deterrents; the damage to corn in the roasting ear is the most vexatious form of damage to this grain of which the crow is guilty. It is not so much the corn the crow actually eats at this time, as it is the subsequent injury resulting from water entering the ears from which the husks have been partially torn, that makes such attacks among the most serious with which the farmer has to contend.

Other Grains.

Of the smaller grains, which together form about an eighth of the food of the adult crow, wheat is the favorite. This was present in 227 of the 1,340 stomachs examined, and it apparently takes the place of corn in the crow's diet in regions where corn is not raised extensively. Stomachs collected in the Northwest illustrate this. When attacks upon wheat are made in sowing or sprouting time, the depredations of a single crow, limited only by a most ample gizzard, may be of considerable consequence. Oats are eaten much less frequently than wheat, and when it is considered that oats are readily available at all times of the year in horse droppings, the quantity of this grain in the diet of the crow need not much concern the farmer. Injury to kafir corn (sorghum) in autumn has been reported from Kansas and Oklahoma, usually in the vicinity of roosts, where many thousands of crows congregate and feed over a comparatively small area day after day during fall and winter. Buckwheat also is occasionally eaten, but by far the largest portion of it is waste.

Other Crops.

A number of other crops are subject to damage by crows. In Southern States, depredations on ripening watermelons have some-

times resulted in heavy losses. Apples, peanuts, pecans, and almonds are less frequently injured; while the aggregate losses to such crops as beans, peas, figs, oranges, grapes, and cherries are insignificant.

Wild Fruits.

Only about 14 per cent of the adult crow's sustenance is at present derived from wild fruits and nuts, a source whence it originally obtained all of its vegetable food. This part of its diet is secured from a variety of sources, but chiefly from acorns and chestnuts. Fruit of the various sumachs, poison ivy and poison oak, bayberry, dogwood, sour gum, wild cherries, grapes, Virginia creeper, and pokeberry are also common ingredients in the food.

DISTRIBUTION OF SEEDS.

The mere consumption of wild fruit by the crow involves nothing of economic importance, but as its digestive processes destroy practically none of the embryos of the seeds, the bird acts as an important distributor of certain noxious plants, as poison ivy and poison oak. In this work, however, it is only supplementing the activities of the many other native birds which feed on these seeds, often to a greater extent than does the crow. Furthermore, as most of these seeds are eaten by the crow during the winter, a large part of those regurgitated are deposited at their roosts, often in dense stands of timber, where the chances for sprouting are poor.

Table II.—*Percentages of the principal food items of the nestling crow.*

May beetles.	Ground beetles.	Other beetles.	Grasshoppers.	Bugs.	Caterpillars.	Miscellaneous insects.	Spiders and myriapods.	Crawfish.	Fish and mollusks.	Amphibians and reptiles	Wild birds and eggs.	Poultry and eggs.	Rodents.	Other mammals.	Carrion.	Corn.	Miscellaneous vegetable matter.
17.44	3.90	2.59	14.60	2.61	5.34	1.88	9.68	1.78	0.68	7.04	1.57	1.60	6.22	2.61	3.95	11.91	4.58

SUMMARY OF FOOD HABITS.

The crow's consumption of insects presents the strongest argument in the bird's favor. About a fifth of its diet is secured from the insect world, and among the pests it destroys are some of the most troublesome with which the farmer has to contend. Many of the insects it eats are taken early in spring, when their life cycles are at the lowest ebb and when their destruction results in the greatest good.

Conspicuous among such food items are May beetles and their destructive larvæ, white grubs, of which the crow is an effective enemy. In its consumption of grasshoppers the crow probably renders man its greatest individual service, and in regions where these insects are

abundant their nymphs form the principal insect food of the nestlings. Other creatures in the destruction of which the young exceed the adults include caterpillars and spiders. The latter, however, are predacious and to a great extent beneficial.

The crow's feeding on reptiles and amphibians is on the whole not to the best interests of man, but fortunately the highly beneficial toads are found in the food less frequently than the more aquatic frogs and salamanders. In feeding on the eggs and young of small

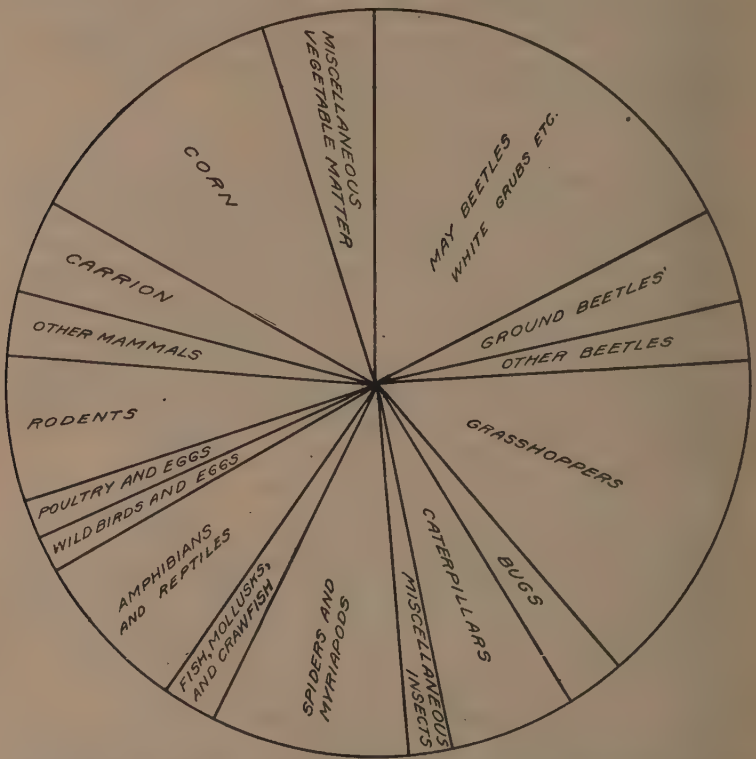

FIG. 4.—Food of nestling crows. The proportions of the various elements are represented by the relative sizes of the sectors. In Table II the same information is presented in percentages.

insectivorous and game birds the crow commits a serious offense, and in the vicinity of game farms and preserves the bird must be held in check if other species are to exist in concentrated numbers. This offense is mitigated somewhat by the fact that most of the depredations on eggs occur early enough in the season to permit the raising of a second brood at a time when there is little or no danger from the crow. The molesting of poultry is an injurious habit against which protective measures are effective under any but the shift-by-

itself method of caring for fowls. A little attention to the screening of young chicks and the suitable housing of setting hens will obviate most losses of this kind. In its feeding on small mammals, its annoyance of young live stock, and its consumption of carrion, the crow has tendencies about equally divided between good and bad. The accusation that it is a dominant factor in the distribution of live-stock diseases has little substantiating evidence.

Of the vegetable food, corn is the principal item. It is the crow's staff of life and furnishes over 38 per cent of its annual sustenance. In the consumption of this grain the bird comes in most frequent conflict with the farmer. Much of the corn eaten, however, is secured from October to March, when waste grain necessarily forms a large part of the supply. Deterrents, as coal tar, on the seed have lessened losses to sprouting grain, especially in small isolated fields, but, when "in the roasting ear," the corn crop is subject to annoying and destructive attacks by the crow, difficult to prevent. The crow also levies a certain toll on small grains, as wheat and sorghums; melons are subject to attack and even cultivated fruits at times are damaged.

The offenses of which the crow has been accused outnumber its good deeds, but this does not mean that they are equal in importance. Many of the crow's depredations may be lessened or entirely prevented by protective measures, while in its preying on insects it does work that can ill be spared. An overabundance of these birds is not to the best interests of the farmer, but, on the other hand, extermination of the crow would result in taking away a most effective enemy of certain insect pests. Consequently the instituting of control measures is justifiable locally where the birds are taking more than a fair share of the crops in return for good services rendered, while in other sections where crows occur in normal numbers they may better be allowed to exist unmolested.

PROTECTION OF CROPS AND POULTRY.

FRIGHTENING DEVICES.

It is not necessary to describe in detail the many well-known devices employed as "scarecrows." The time-honored straw-stuffed human effigy is the one most frequently used, though often it fails to accomplish its purpose. Various unusual objects, as pieces of shining tin moving in the wind or glass bottles hung about fields, windmills operating a noise-producing mechanism, newspapers placed on the ground, twine stretched about and across fields from poles stationed at intervals around them, as well as bodies of dead crows hung in conspicuous places, have been successful in some instances. Poultry yards especially have been protected from the ravages of crows by strands of cord stretched across at intervals and at a height of 6 or 8

feet from the ground. One or another of these methods has met with varying success on occasion, but sometimes none will produce the desired results. None can be considered infallible.

DETERRENTS.

Coal tar.—Experience has shown that damage to corn and other grains at sprouting time may be lessened by special treatment of the seed. While the application of deterrents to the seed grain has disadvantages, in that it involves additional labor at planting time, tends to retard germination in periods of dry weather, and can not be considered an absolute cure, the measure of success of many farmers who have in this manner secured relief from crow depredations warrants a description of the methods used.

One of the most successful deterrents is coal tar, a cheap by-product in the manufacture of illuminating gas, which may be secured at gas works or at some paint shops. It is a dark, heavy liquid of about the consistency of thin molasses and emits a strong, gassy smell for some time, even after the grain treated with it has become thoroughly dry. When used in the quantities here recommended, coal tar in no way injures the germinating qualities of the seed. This important qualification is not possessed by certain other substances, sometimes recommended as crow deterrents. Experiments conducted by the writer also have shown that in periods of normal rainfall germination is but slightly retarded by the coal-tar treatment, though in periods of drought the retardation may be several days.

Coal tar should be used in the proportion of about a tablespoonful to half a bushel of seed grain, the grain having been previously heated by the application of warm water, and then drained. A continued stirring of the grain will eventually result in an even coating of tar. The seed may then be spread out on a dry surface or may be dried by the application of an absorbent medium, as ashes, land plaster, or powdered earth. When thoroughly dry it may be used in a planter.

Deterrents are commonly used by farmers of the North Atlantic States and to a lesser extent by farmers of the South Atlantic States. In the extensive corn-raising regions of Illinois, Missouri, and Iowa, corn is seldom tarred, probably because it is planted on so large a scale that losses to the individual farmer are less severe.

Red lead.—Another substance used as a deterrent is red lead. This appears to have been used first in Europe, where it met with considerable success. The grain is first given a thin glue size, and is then drained and dusted with red lead until well colored. Though this process has been used but little in this country, its success in deterring birds in Europe warrants a further trial here.

Other deterrents.—A few years ago the Kansas State Agricultural College Experiment Station conducted a series of experiments on seed grain to ascertain the usefulness of certain deterrents against burrowing animals. Incidentally the effect of these various substances upon the germinating powers of the seed was investigated. In his report on this work, Theo. H. Scheffer[1] says in part that kerosene, crude petroleum, copperas, crude carbolic acid, fish oil, and spirits of camphor, when used in sufficient quantity or strength to impart an odor to the corn, seriously injure the germinating powers of the grain; and that to treat the seed with any of these substances in such small quantity or dilute form as not to injure the germ is a waste of time, for the slight taste or odor imparted is soon dissipated in contact with the soil.

Similar experiments[2] conducted by B. M. Duggar and M. M. McCool, at the Agricultural Experiment Station of Cornell University, indicated that of a number of substances employed, turpentine emulsion and an anilin oil solution seriously affected germination. Such substances should be carefully avoided.

The manufacture of deterrents for use on seed grain has been undertaken on a moderate scale in this country, and a few articles of this nature also have been imported. Most of these appear to use coal tar or closely related products as a base; one at least contains a copper salt and is a poison; while the merit of one imported deterrent appears to be based on the fact that the treated seed is a brilliant blue. None of those tested by the writer has had any harmful effect on the seed; but there is no evidence that any of these manufactured substances is superior to coal tar as a deterrent when the latter is properly applied.

SCATTERING GRAIN.

Many farmers have had considerable success in protecting their sprouting crop by spreading broadcast over the fields a quantity of grain previously softened with water. This the birds take, leaving untouched that which has been planted. It has been found that a comparatively small quantity sacrificed in this way during the short period of a week or 10 days when spouting corn is subject to damage has often prevented loss to the growing crop.

POISONING.

Though the crow would be a most difficult bird to eradicate over any considerable area by a campaign of poisoning—a fact due largely to the bird's wariness—such a method has been found an effective means of protecting crops. When once a flock of these birds have

[1] Kansas State Agr. Coll. Exp. Sta., Circ. 1, p. 3, Apr. 28, 1909.
[2] Cornell Univ. Agr. Exp. Sta., Circ. 6, pp. 14–16, May, 1909.

learned through the loss of one or several of their number that a certain area has been baited with poisoned food they are inclined to avoid it for some time at least. In conducting such operations, however, local regulations governing the distribution of poison must be scrupulously observed, and as there is always an element of danger connected with the distribution of poison about thickly settled regions, its use should be limited and judicious.

Corn is the bait usually employed in poisoning crows, and it is generally prepared by simply steeping the grain in a strong strychnine solution. If made, however, according to the following directions it will kill more quickly and its effectiveness will last for a considerable time when exposed to weather:

Corn	20 quarts
Strychnine (powdered)	1 ounce
Starch	2 tablespoonfuls
Water	1½ pints

Put the starch and strychnine in the water and heat to boiling, stirring thoroughly after the starch begins to thicken. Pour this mixture over the corn and stir till every kernel is coated. The seed may then be spread out and dried.

Experiments conducted in Klickitat County, Washington, demonstrated that where crows are troublesome to green almonds, relief may be secured by using these nuts as bait, prepared by splitting and inserting a quantity of a strychnine-saccharine mixture of about the size of a kernel of wheat. The poison mixture is composed of 8 parts of strychnine alkaloid and 1 of saccharine. The poisoned nuts are then placed in bare spots, two or three under each tree. While such a limited number of baits appears to be wholly insufficient to meet a situation where a flock of several thousand birds settle down on an orchard of a few acres, the results secured thus far have been most satisfactory. In attacking an almond crop, crows will first alight in the tree tops, knock down a few nuts, and then go to the ground to feed on them. For this reason conspicuously placed poisoned baits of this kind are almost certain to be taken, and as a few crows killed or seriously affected by the poison will suffice to make others shun the area, protection has been secured by one treatment that lasted a week or 10 days. By this means almond crops that in previous years had suffered losses sometimes totaling 100 per cent were but slightly damaged.

A successful bait has also been prepared by the use of partially blown hens' eggs into which a small quantity of strychnine has been injected. This has been effective in stopping the raids of the poultry and egg stealing crow. It should always be placed on the tops of straw stacks, in artificial nests erected on poles, or in inclosures from which poultry and all farm animals are barred. Strychnine may even be conveyed by meat or carrion used as baits, but the difficulty

in keeping such baits away from domestic animals is great; they may be used to best advantage in winter, when crows are hard pressed for food.

TRAPPING.

Trapping at times has brought relief where other methods have failed. No wholesale reductions in the number of crows has ever been accomplished by this method, but when a few birds have been trapped and their dead bodies have been left exposed in the fields, their relatives are inclined to shun the immediate vicinity. Crows have been secured mainly in steel traps carefully baited with hens' eggs.

SHOOTING.

The unusual wariness of the crow has limited the effectiveness of firearms in reducing its numbers. However, these birds are inclined to shun those areas where the shotgun is frequently used. The use of crow decoys and crow calls has been resorted to with such success in attracting the birds within gunshot that these articles are now placed on sale by extensive dealers in sporting goods. A mounted specimen of an owl placed in a conspicuous position and within easy gunshot of the concealed hunter has also been used successfully in attracting numbers of crows to a point where they can be shot.

In eradicating objectionable winter roosts of crows, attacks on several successive nights by a number of men with firearms will frequently cause the birds to move on. Cartridges loaded with black powder are better than those containing smokeless, as the report is more deafening. When once a roost has been removed, vigilance must be employed for some time thereafter to keep it from being reestablished. In places where the discharge of firearms was inadvisable, Roman candles shot among the roosting birds have brought about the desired results, and on one occasion bunches of firecrackers thrown up into the tree tops caused the crows to seek a more peaceful community.

DESTROYING NESTS.

In sections where woodlands are close to farmyards containing exposed nests and young chicks, the destruction of a few crows' nests will greatly lessen depredations on poultry. The success of this measure lies in the fact that most of the crow's raids on the poultry yard are prompted by its desire to secure food for its young.

SUMMARY.

The crow is a bird whose size, ability to survive under diverse environments, and almost omnivorous food habits make it capable of doing both serious harm and extensive good. The influence of the race as a whole for good and harm appears to be about equal. Local

conditions, however, greatly affect its economic status, and for this reason hasty judgment as to its worth should not be rendered, lest the bird be persecuted in sections where it is actually aiding the farmer. This bulletin has aimed to point out briefly the benefits to man from the crow's food habits, as well as the ways in which the bird may do harm. Indiscriminate killing is not warranted, and even in areas where the crow is doing harm preventive measures will often put a stop to the nuisance and allow the bird to continue what good work it may be doing on insects. Among the preventive measures are—

(1) The use of coal tar or other deterrents on seed grain.

(2) Scattering grain over fields where the crop is just sprouting.

(3) Stretching twine about and across fields from poles stationed at intervals. A network of such strands is often effective in protecting poultry yards.

(4) The use of frightening devices and the hanging up of the dead bodies of crows in conspicuous places.

In places where more drastic measures are necessary the killing of even a few crows will intimidate others and these will usually shun the area for some time. Such procedures include–

(1) The use of poison (strychnine) in places where this is permitted by law. Corn and hens' eggs are the most effective baits.

(2) Trapping by means of steel traps, carefully concealed and baited with hens' eggs.

(3) Destroying nests—a measure that will most frequently put a stop to the poultry-raiding activities of a pair of crows which have their nest near by.

(4) Shooting—the hunter being aided by the use of a crow call and, where possible, also by a mounted owl placed conspicuously on a pole. Several night attacks by a number of men equipped with shotguns will frequently remove objectionable winter roosts.

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